

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

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| In the Matter of |) | |
| |) | |
| Amendment of Section 15.255 of the |) | ET Docket No. 21-264 |
| Commission's Rules |) | |
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COMMENTS OF AMAZON.COM, INC.

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Amazon.com, Inc. (“Amazon”) submits these comments in response to the Federal Communications Commission’s (“FCC” or “Commission”) Notice of Proposed Rulemaking (“*NPRM*”) in the above-captioned proceedings.¹ The *NPRM* seeks to establish operational and technical rules for field disturbance sensor (“FDS” or “radar”) devices in the 57-71 GHz band (“60 GHz band”) that will promote the development and deployment of such technologies.

I. INTRODUCTION AND SUMMARY

Amazon supports the Commission’s work in this proceeding to facilitate the manufacture and use of innovative radar technologies in the 60 GHz band. The *NPRM* aptly recognizes “the increasing practicality” of using mobile FDS devices to carry out “innovative and life-saving functions,” such as “gesture control, detection of unattended children in vehicles, and monitoring of vulnerable medical patients.”² Amazon agrees that promoting a vibrant FDS device ecosystem in the 60 GHz band will yield compelling consumer benefits. To ensure that the band reaches its full potential, the Commission should further liberalize the operational and technical rules set

¹ *Amendment of Section 15.255 of the Commission’s Rules*, Notice of Proposed Rulemaking, ET Docket No. 21-264, FCC 21-83 (2021) (“*NPRM*”).

² *Id.* ¶ 1.

forth in Section 15.255³ to promote innovation in the 60 GHz band and facilitate greater FDS device development and usage. In particular, Amazon supports the Commission’s proposal to authorize FDS devices in the 57 to 64 GHz band at 20 dBm EIRP without any coexistence measures. Amazon, however, urges the Commission to consider extending 20 dBm EIRP FDS operation across the entire 14 gigahertz of the band to promote FDS deployment. However, for any device operating above 20 dBm EIRP across the entire 60 GHz band the Commission should implement listen-before-talk (“LBT”) or spectrum sensing coexistence measures for both radar and communications devices operating at power levels in excess of 20 dBm EIRP. Such an approach would help ensure that different devices and use cases could effectively coexist in the 60 GHz band.

Additionally, Amazon supports the Commission’s proposal to eliminate existing Section 15.255 waivers, provided that any rule changes adopted in this proceeding are not more technically and operationally onerous than the FDS waivers. Should the new 60 GHz rules be more restrictive than existing waivers, the current waivers should be grandfathered, or, at a minimum, waiver holders should be allowed a reasonable transition period to bring their equipment into compliance with the new rules.

While Amazon generally supports the *NPRM*’s proposed technical parameters, the Commission should further refine its technical and operational rules for FDS devices in the 60 GHz band. Specifically, the Commission should ensure that the rules it adopts promote flexibility and foster innovation. The Commission should: avoid requiring the use of listen-before-talk (“LBT”) or other coexistence measures if FDS devices are operating at 20 dBm EIRP or below; decline to impose transmitter conducted output power limits on radar devices

³ 47 C.F.R. § 15.255.

implemented at the chip level; and ensure that any transmitter conducted output power limit or antenna gain limit adopted is not more restrictive than a 10 dBm conducted output power should the Commission maintain the conducted power limit or adopt an antenna gain limit.

Additionally, consistent with international standards, the Commission should preserve the status quo and reject calls to adopt duty cycle limits in the 60 GHz band. Imposing any duty cycle limits would frustrate international harmonization, as ETSI EN 305 550 does not specify any duty cycle limit. Worse, duty cycle limits would unnecessarily stifle innovation by restricting FDS device use cases. Limiting average power levels would be a more effective approach to interference mitigation in the band.

Finally, the Commission should simplify its rules by eliminating the distinction between “fixed” and “mobile” FDS devices and adopting a use case-agnostic definition. A neutral use case approach to defining FDS devices will promote flexibility and innovation in the band. The Commission should go further and permit operations at this level for both fixed and mobile radars. Additionally, the Commission should authorize onboard use of FDS devices for UAS in the 60-64 GHz band, and should consider appropriate safeguards against harmful interference to adjacent band operations. Modifying the proposed rules as detailed herein will spur greater FDS deployment, bringing numerous innovative benefits to the public.

II. AUTHORIZING FDS DEVICE OPERATION THROUGHOUT THE 60 GHZ BAND FURTHERS THE DEVELOPMENT AND DEPLOYMENT OF RADAR TECHNOLOGY.

Amazon supports authorizing FDS devices to operate at 20 dBm EIRP throughout the 60 GHz band, 57-71GHz, without coexistence measures, as doing so will boost the development and deployment of innovative FDS device use cases.⁴ As the Commission has recognized, FDS

⁴ *NPRM* ¶ 22.

devices may be used to perform innovative and life-saving functions, including gesture control, detection of unattended children in vehicles, and monitoring of vulnerable medical patients.⁵ If permitted access to the full 60 GHz band, FDS devices will thrive, providing compelling benefits to American consumers.

While the *NPRM*'s proposal to limit such operation to the 57-64 GHz segment of the band is consistent with the European Telecommunications Standards Institute ETSI EN 305 550 standard, and therefore promotes international harmonization efforts,⁶ the ETSI standard could alternatively be modified to accommodate the Commission's new rules. Amazon supports uniform international development and deployment of FDS technology, which would allow American manufacturers to achieve economies of scale for 60 GHz radar technology.⁷ To this end, the Commission can lead by authorizing radar use cases throughout the 60 GHz band, which will encourage European regulators to follow suit. This will promote increased FDS flexibility and use cases while building economies of scale.

Additionally, all operations in the 60 GHz band in excess of 20 dBm EIRP should only be permitted with appropriate coexistence measures such as LBT or spectrum sensing to minimize the potential for interference in the band.

III. THE COMMISSION SHOULD ONLY TERMINATE EXISTING 60 GHZ RADAR WAIVERS IF IT ADOPTS MORE FLEXIBLE OPERATIONAL AND TECHNICAL STANDARDS.

The Commission should only terminate previously granted 60 GHz waivers if its new rules are less operationally restrictive for FDS devices than the current Section 15.255 waivers.⁸

⁵ *Id.* ¶ 1.

⁶ *Id.* ¶¶ 21-22.

⁷ *Id.*

⁸ *Id.* ¶ 18.

However, if the new 60 GHz rules are more restrictive, existing waivers should be grandfathered, or, at a minimum, provide a transition period for waiver holders to bring their equipment into compliance with the new rules. The Commission has previously used both grandfathering and multi-year transition periods in similar proceedings,⁹ and should take such action here if the new rules are more onerous than existing waivers.

IV. AMAZON SUPPORTS REVISITING THE OPERATIONAL AND TECHNICAL RULES FOR FDS DEVICES IN THE 60 GHZ BAND.

Amazon generally supports the *NPRM*'s proposed technical parameters – based on the *Google Waiver Order* – for radar operations in the 57-64 GHz band.¹⁰ Regardless of whether the Commission permits FDS operation at 20 dBm EIRP, the current rule provision should continue to allow operation in the band at 10 dBm EIRP without any duty cycle limit to ensure operational flexibility for FDS devices transmitting at lower power.¹¹ Such an approach will best achieve the Commission's twin goals of permitting innovative radar device operation throughout the band without causing harmful interference.¹² Indeed, as the Commission recognized, operations

⁹ See, e.g., *Amendment of Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band*, Report and Order, FCC 17-94 (2017) (establishing transition periods and certain grandfathering mechanisms for 24 GHz band radar device manufacturers and providers transitioning to the 76-81 GHz band).

¹⁰ See *NPRM* ¶ 19 (“Our baseline proposals draw from the technical and operating conditions incorporated into the waivers granted to Google for its Soli device . . . with additional modifications to account for harmonization with international provisions governing operation in the band.”); *Google LLC Request for Waiver of Section 15.255(c)(3) of the Commission's Rules Applicable to Radars used for Short-Range Interactive Motion Sensing in the 57-64 GHz Frequency Band*, Order, ET Docket No. 18-70, 33 FCC Rcd 12542 (2018) (“*Google Waiver Order*”).

¹¹ *NPRM* ¶ 22.

¹² *Id.* ¶¶ 1-2.

pursuant to the technical parameters laid out in the *Google Waiver Order* have proceeded “without reported cases of harmful interference.”¹³

Additionally, and as further explained below, Amazon supports using average power measurements. Amazon also supports exempting Frequency Modulated Continuous Wave (“FMCW”) radars from Section 15.31(c) of the Commission’s rules. The Commission should only impose coexistence measures on FDS devices operating at power levels over 20 dBm EIRP, and should not impose transmitter conducted output power limits on radar devices implemented at the chip level. Finally, whether the Commission uses a transmitter conducted output power limit or an antenna gain limit, any measurement change should not be more restrictive than the 10 dBm limit established in the *Google Waiver Order*.¹⁴ Adopting these technical parameters will encourage widespread development and deployment of advanced FDS device use cases in the 60 GHz band.

Average Versus Peak Power Measurements. Amazon supports the *NPRM*’s proposal to measure power limits – both EIRP and power-spectral density – using an average measurement as opposed to a peak measurement.¹⁵ As the Commission notes, Europe’s ETSI standard utilizes average, rather than peak limits under ETSI Standard EN 305 550, Clause 7.2.¹⁶ Accordingly, modifying the current rules to specify average power measurement will lead to greater international harmonization, decreasing compliance costs for FDS device manufacturers. Accordingly, power measurements must be performed over one or a multiple of repetition cycles of radar waveform.

¹³ *Id.* ¶ 19.

¹⁴ *Google Waiver Order*, 33 FCC Rcd at 12548, ¶ 14.

¹⁵ *NPRM* ¶ 29.

¹⁶ *Id.* ¶ 26.

FMCW Radar Exemption. Amazon supports the Commission’s proposal to exempt FMCW radars from the requirement in Section 15.31(c) to stop the frequency sweep when measuring compliance with the Commission’s rules.¹⁷ Under this proposal, the new rules would specify that an FMCW radar frequency sweep may continue while the relevant technical parameters are measured. As the Commission notes, stopping the frequency sweep is “physically impractical” for FMCW radars and “can result in inaccurate measurements” because “[a]n FMCW radar works by sweeping a continuous wave [(“CW”)] signal over a defined frequency range.”¹⁸

60 GHz Band Coexistence Measures. The Commission should not require the use of LBT or other coexistence measures for FDS devices, unless those devices are operating at transmission powers in excess of 20 dBm EIRP. Coexistence measures are unnecessary for FDS devices operating at power levels at or below 20 dBm EIRP because such devices are unlikely to cause harmful interference to unlicensed communications devices.¹⁹ Indeed, unlicensed communications devices operating in the 60 GHz band must already function in the proximity of other unlicensed communications and other Part 15 devices which transmit higher power levels.²⁰ That said, the Commission should require coexistence measures for FDS and communications devices operating at power levels above 20 dBm EIRP to minimize the potential for interference.

¹⁷ See *id.* ¶ 45; 47 C.F.R. § 15.31(c) (“[F]or swept frequency equipment, measurements shall be made with the frequency sweep stopped at those frequencies chosen for the measurements to be reported.”).

¹⁸ *NPRM* ¶ 45.

¹⁹ See *id.* ¶¶ 24, 38.

²⁰ *Id.* ¶ 24.

Radar Devices Implemented at the Chip Level. The Commission should not impose transmitter conducted output power limits on radar devices implemented at the chip level, because, as the *NPRM* correctly states, “access to the transmitter output port may not be available, rendering a demonstration of compliance to this requirement burdensome.”²¹ The same holds true for antenna-on-package systems, also known as “system-on-chip” devices.²² Because it may not be possible to measure conducted power for such devices, imposing transmitter conducted output power limits would be impractical.

Transmitter Conducted Output Power Versus Antenna Gain. Regardless of whether the Commission replaces the transmitter conducted output power limit with an antenna gain limit,²³ any measurement change should not be more restrictive than the 10 dBm limit set forth in the *Google Waiver Order*.²⁴ A more restrictive measurement would complicate the FDS device technology development and deployment already underway in connection with waivers that the Commission has granted.²⁵

V. THE COMMISSION SHOULD NOT IMPOSE DUTY CYCLE RESTRICTIONS ON RADAR DEVICES.

The Commission should preserve the status quo and refrain from imposing any duty cycle restrictions on FDS devices operating in the 60 GHz band. Such an approach is generally consistent with ETSI EN 305 550, which, as the Commission notes, does not set forth a duty

²¹ *Id.* ¶ 26.

²² With “system-on-chip” devices, the antenna is on the FDS device chip. *Id.* ¶ 26.

²³ *Id.*

²⁴ *Google Waiver Order*, 33 FCC Rcd at 12548, ¶ 14.

²⁵ See, e.g., *Vayyar Imaging Ltd. Request for Waiver of Section 15.255(c)(3) of the Commission’s Rules for Radars used for Interactive Motion Sensing in the frequency band 57-64 GHz et al.*, Order, DA 21-407, 36 FCC Rcd 7218, 7235, ¶ 53 (2021); *Google Waiver Order*, 33 FCC Rcd at 12548, ¶ 14.

cycle requirement for 60 GHz short-range devices.²⁶ Moreover, as stated below, imposing the “off time” duty cycle restrictions will severely constrain fixed FDS use cases that rely on the ability of radar to estimate Doppler. Accordingly, duty cycle restrictions would reduce flexibility for FDS operations in the 60 GHz band and contravene the Commission’s stated interest in “expand[ing] operational flexibility” to FDS devices operating in the 60 GHz band.²⁷

New rules for FDS device operation in the 60 GHz band can only achieve the Commission’s stated goal of “expand[ing] the opportunities for unlicensed FDS operations in the band to the greatest extent possible” if they adequately support the performance capabilities of FDS devices.²⁸ A duty cycle restriction, however, could impose significant performance encumbrances on FDS devices. Many FDS devices need to transmit frequent chirps that span an adequate burst time in order to prevent velocity aliasing and enable strong velocity resolution.²⁹ A duty cycle restriction could prohibit these devices from doing so, thereby significantly hindering their functionality. While some stakeholders advocating for the off-time proposal are concerned that the lack of a duty cycle limit will lead to interference, these concerns do not adequately account for radars’ lower transmission power, “low potential to generate interference, and antenna directionality, as well as propagation loss in the 60 GHz band.”³⁰ Imposing duty cycle restrictions could therefore stifle innovation and harm the public interest by preventing

²⁶ ETSI EN 305 550-1 V1.2.1 (2014-10), https://www.etsi.org/deliver/etsi_en/305500_305599/30555001/01.02.01_60/en_30555001v010201p.pdf; *see* NPRM ¶ 30.

²⁷ NPRM ¶ 1.

²⁸ *Id.* ¶ 14.

²⁹ *See* Letter from Megan Anne Stull, Google LLC, to Marlene Dortch, FCC, ET Docket No. 21-48 (May 17, 2021) at 2.

³⁰ *See id.* at 3.

certain FDS devices from providing the “innovative and life-saving functions” that the Commission recognized as the impetus for initiating this rulemaking proceeding.³¹

FDS are unable to sense during the transmission-off period required by duty cycling. These restrictions result in degraded Doppler resolution and increased Doppler ambiguity, which are detrimental to use-cases that rely on the ability of FDS to estimate Doppler. Additionally, these restrictions impact both maximum range (due to lack of coherent pulse integration) and angular accuracy (where multiple antennas are forced to share the transmission-on time in a time-division multiplex manner) adversely. Since other unlicensed band users are allowed to use the entire 14 GHz of bandwidth at 40 dBm EIRP without any duty cycle restrictions, allowing FDS to operate without any duty cycle requirement will create a level playing field for FDS devices.

Rather than imposing a burdensome duty cycle restriction, the Commission should instead address any potential interference issues by adopting limitations on average and peak power in a particular band. This interference mitigation strategy would help better achieve the desired coexistence among unlicensed devices in the 60 GHz band and would strike an appropriate balance between providing FDS devices with operational flexibility while still ensuring that unlicensed devices in the 60 GHz band do not cause harmful interference.

In the event the Commission decides to adopt a duty cycle, it should reject any further restrictions in which any radar off-time period between two successive radar pulses that is less than 2 milliseconds would be considered “on time” for purposes of calculating the duty cycle.³²

³¹ *NPRM* ¶ 1.

³² Letter from Alan Norman, Facebook, Carlos Cordeiro, Intel, & John Kuzin, Qualcomm, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 21-48 et al., at 2-3 (filed May 10, 2021).

This restriction would further degrade FDS device performance, as it would either significantly lower velocity resolution or lead to artifacts in doppler processing.

VI. THE COMMISSION SHOULD ELIMINATE THE DISTINCTION BETWEEN “FIXED” AND “MOBILE” FDS TO PROMOTE CLARITY.

Amazon supports eliminating the distinction between “fixed” and “mobile” FDS to take an agnostic use case approach that will provide greater regulatory certainty for FDS manufacturers.³³ Specifically, the Commission should adopt an expanded definition of FDS that includes all fixed, portable, and mobile use cases. As the Commission notes, this exception has been the source of “much confusion” over “which 60 GHz mobile and fixed radar applications should qualify under the SRIMS designation.”³⁴ To eliminate this confusion and promote flexibility, the Commission should replace the SRIMS exception with a general rule covering both fixed and mobile FDS devices, as it has done in the past when such distinctions “appear to no longer be necessary.”³⁵

VII. THE COMMISSION SHOULD CONTINUE TO PERMIT HIGH POWER FDS DEVICE OPERATION IN THE 61-61.5 GHZ BAND.

Amazon supports the Commission’s proposal to retain Section 15.255(c)(2), which permits fixed FDS device operation at up to 40 dBm average EIRP and at up to 43 dBm peak EIRP in the 61.0-61.5 GHz band segment. Amazon agrees with the Commission that “this rule is

³³ *NPRM* ¶ 37.

³⁴ *Id.* ¶ 34.

³⁵ *See, e.g., Amendment of Part 22 of the Commission’s Rules to Benefit the Consumers of Air-Ground Telecommunications Services, et al.*, Report and Order and Notice of Proposed Rulemaking, WT Docket Nos. 03-103, 05-42, 20 FCC Rcd 4403, 4452, at ¶ 124 (2005) (eliminating directional differing antenna technical requirements for fixed and mobile operations in the 800 MHz commercial Air-Ground Radiotelephone Service band because the Commission’s current licensing procedures provide “greater flexibility to licensees to use the spectrum for mobile or fixed operations”).

valuable insofar that it permits the operation of fixed FDS devices at power levels as high as communication devices.”³⁶

VIII. THE COMMISSION SHOULD PERMIT AIRBORNE USE OF RADAR DEVICES FOR UAS IN THE 60-64 GHZ SEGMENT OF THE BAND.

The Commission should authorize FDS device use cases on board aircraft in the 60-64 GHz segment of the 60 GHz band for unmanned aerial systems (“UAS”).³⁷ As the Commission notes, it is not aware of any interference reports caused by Google Soli FDS devices during airborne use,³⁸ and it has previously granted a waiver for 60 GHz radar use on board a UAS to “provide visual inspection of structures in engineering and scientific applications to prevent the UAS from colliding with the structure or other fixed objects that it is surveying.”³⁹ Amazon would like to deploy onboard 60 GHz radar for similar UAS use cases – obstacle avoidance and situational awareness.

The unique characteristics provided by 60 GHz radar make it an enabling technology in the improvement of the public safety of UAS systems. Indeed, in the *Leica Waiver Order*, the Commission concluded that such 60 GHz radar use cases “provide substantial public benefit in improving safety and enhancing opportunities for scientific, commercial, and engineering applications.”⁴⁰ Specifically, the Commission found that use of a 60-64 GHz radar on board

³⁶ *NPRM* ¶ 35.

³⁷ *Id.* ¶¶ 42-43.

³⁸ *Id.* ¶ 42.

³⁹ See *id.* ¶ 43 (citing *In the Matter of Leica Geosystems AG Request for Waiver of Section 15.255 of the Commission's Rules Applicable to Radars used on Unmanned Aerial Vehicles in the 60-64 GHz Frequency Band*, ET Docket No. 19- 350, DA 20-795, Order, FCC Rcd 7929 (2020) (“*Leica Waiver Order*”)).

⁴⁰ *Leica Waiver Order* ¶¶ 4-9.

Leica Geosystems AG’s Ictos system drone allowed the company to avoid collisions with building structures and falling debris.⁴¹ This, in turn allowed Leica to operate a UAS close to a building which could “improve safety considerations for property and people, and could facilitate applications such as assessing structural integrity of buildings in danger of collapse after natural disasters.”⁴² Moreover, to prevent any harmful interference to Earth Exploration Satellite Service operations in the 57-59.3 GHz band, Amazon supports reasonable protections.

IX. CONCLUSION

As set forth above, Amazon supports the Commission’s efforts to authorize FDS device operation throughout the 60 GHz band. Amazon encourages the Commission to adopt a flexible framework and to liberalize the operational and technical rules for FDS devices in the 60 GHz band. This approach will facilitate a robust ecosystem for FDS devices, greatly advancing the substantial benefits that FDS devices bring to the public’s daily life.

Respectfully submitted,

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⁴¹ *Id.* ¶ 9.

⁴² *Id.*